New Detector at RHIC
Descoping Considerations

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#1: One is going to lose some physics by descoping (unavoidable)
I liked Ed's focus on what can be bought back later…

#2: One cannot "make the sPHENIX physics case" without tracking capabilities (we learned that through 2.5 years of reviews)
Upsilon physics and tracks within jets must be preserved

#3: Re-using the current PHENIX VTX pixels is not a good option even in a de-scoped scenario (*see later slide for details)

#4: From Friday's discussion, we are asked to consider a physics performance from a scenario with -$4M in equipment x 1.4 contingency (ignore any savings < $0.4M, i.e. < 10%)

We should present a clear picture of multiple scenarios we considered and the consequences… and then choose an example "best worst case"
ALD wants to see that this exercise is taken seriously and it gives us an opportunity to make a clear case for how to recover key physics.

AY k$'s - with Extraordinary Construction Overhead Application

WBS	SYSTEM	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	Total
1.1	Project Management	1,199	1,285	1,276	1,319	998	6,077
1.3	Tracker	374	1,186	3,447	0	13	5,020
1.4	EMCal	127	647	1,401	2,024	0	4,198
1.5	Hcal	0	2,353	4,044	166	0	6,562
1.6	Calorimeter Electronics	120	2,444	2,401	0	0	4,965
1.7	DAQ& Trigger	80	190	29	1,726	0	2,025
	MIE Contingency @40%	760	3,242	5,039	2,094	404	11,539
	Operations Support	2,448	2,219	4,389	2,926	374	12,357
	Operations Contingency @40%	979	888	1,756	1,170	150	4,943
	MIE with Contingency	2,659	11,346	17,637	7,330	1,415	**40,386**
	Operations - Labor to support MIE with Contingency	3,428	3,107	6,145	4,096	524	17,300

What are some options to save $4M (and with contingency x1.4) from the red boxed items?

Consideration A

1.6 Calorimeter Electronics → $4.9M
EmCal electronics completely dominates the cost
Almost all purchases (not engineering) that scales with channel count

One Option – can we build all the EMCal towers, and gang the readout 2x2 → saves $3M

Minimal impact on jet and direct photon physics (direct photons > 15 GeV where they dominate is already beyond 2γ separation anyway).

Straightforward for Jin to evaluate degraded e/p separation. Main impact is worse S/B for Upsilon physics in Au+Au.

Can one work this option and what is the critical time if one got more funds to buy the channels back.

Consideration B

1.4 EmCal Towers → $4.2M
1.6 Calorimeter Electronics → $4.9M
EmCal towers dominated by material costs – labor included elsewhere

One Option – can we build only half the EmCal Towers
→ Saves $2.1M (towers) + $2M (electronics) = $4.1M

Could cover |eta| < 0.5 and plan to build out as much as possible later.

- Direct photon physics acceptance down by factor of 2.
- Upsilon physics down by a factor of ~4 (easy to check w/o GEANT).
- What is jet resolution in region with only HCal (easy to check with GEANT) – boundary region is not great, but probably correctable.

Are there support issues that need to be designed in to add more full phi rings expanding out in eta later?

Consideration C

1.4 Hadronic Calorimeter Towers → $6.6M
Most of the cost is dominated by machined steel, channel count for electronics is small compared to EmCal.

One Option – split the outer HCal into two longitudinal segments and only build the inner one (i.e. reduce the total calorimeter number of interaction lengths). → saves (?) - $2-3M depending on split

* Note that one actually only needs a fraction of the HCal outer steel to return the flux. Note later it doubles the outer HCal electronics

• Main impact hadronic energy and jet energy resolution – low side tail due to fluctuations in energy leakage (easy to quickly GEANT evaluate)

Can one work this option and what is the critical time if one got more funds to buy the outer most section back? Re-engineer support?

Consideration D

1.7 DAQ & Trigger→ $2.1M
Not sure about the breakdown here.

One Option - One could multiplex the data to the DCM 2 modules (reducing them by x2) → saves (?)

- Factor of 2 reduction in Au+Au min.bias rate
- No impact on highest energy photon/jet physics, and for pp pA
- Biggest effect is loss of x2 in Upsilons and lower energy jets

Again need a detailed breakdown of the $2.1M

Consideration E

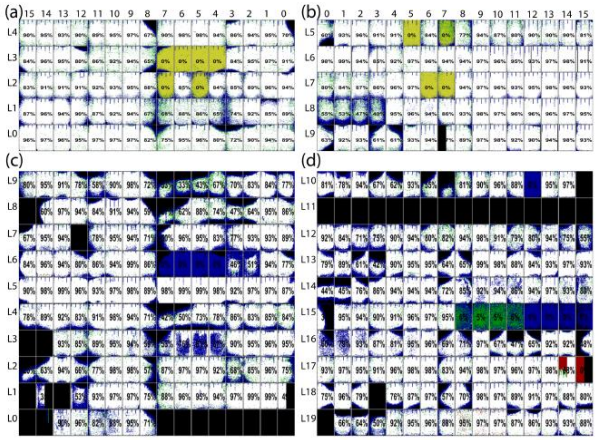
1.3 Tracker→ $5.0M
Not sure about the breakdown here.
Is this $0.0M for re-using the VTX pixels and a TPC?

I believe at this point re-using the VTX pixels is a fiction (see the next slide), and that we should put this option aside.
I also have major concerns about the TPC option (really early R&D and no realistic simulation on the horizon for evaluation).

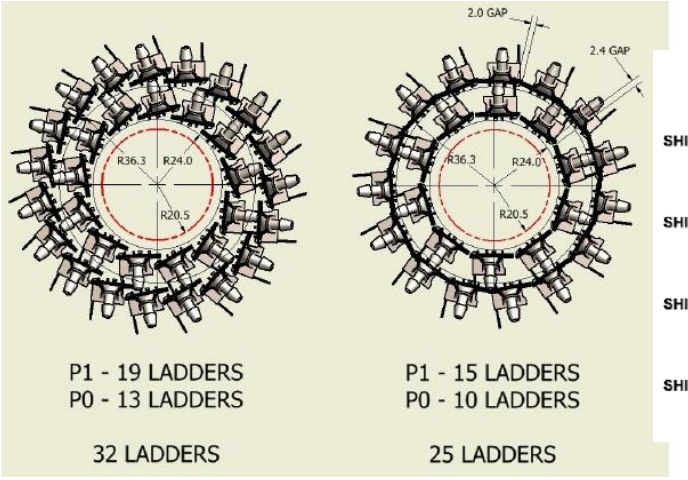
My recommendation to at least pursue is MAPS with one inner pixel layer and reduced N-- outer layers costed to around < $6M.
Evaluate performance for resolution (potentially moving outer layer in) and pattern recognition for Upsilon (with EmCal match) and hadrons (with Calo match).

Lots of physics and political power to push to recover more. Cutting edge and has potential to be "great detector". This may mean cutting even more in other areas to make this realistic.

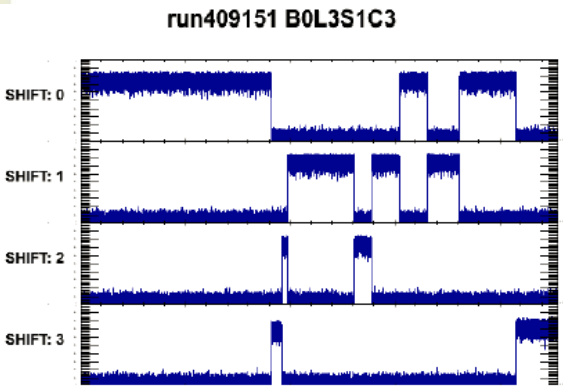
PHENIX two layers of VTX pixels…



Major dead areas
Two layers is already under-designed.
No path to recover excellent tracker.



Essentially no good spares.
Layout on the right would be a Complete checkerboard acceptance



Large number of pixel chips send out the wrong event data (can be re-sorted in offline)…
No true expert team remains…

I believe there is no way to do b-tag physics.
I believe the checkerboard acceptance will cause permanent analysis issues, and will be very hard to defend to any review committee.
Perhaps one can make one optimized layer to help with pattern recog.